

**2004 GALVESTON BAY INVASIVE SPECIES RISK ASSESSMENT**  
**INVASIVE SPECIES SUMMARY**

Created by: Environmental Institute of Houston, University of Houston-Clear Lake  
and the Houston Advanced Research Center

<b>Common Name:</b> Grass carp (white amur).
<b>Latin Name:</b> <i>Ctenopharyngodon idella</i>
<b>Category:</b> Aquatic Animal
<b>Place of Origin:</b> “Eastern Asia from the Amur River of eastern Russia and China south to West River of southern China (Lee et al. 1980 et seq.; Shireman and Smith 1983) ( <a href="http://nas.er.usgs.gov/fishes/accounts/cyprinid/ct_idell.html">http://nas.er.usgs.gov/fishes/accounts/cyprinid/ct_idell.html</a> ).”
<b>Place of Introduction:</b> “... aquaculture facilities in Auburn, Alabama, and Stuttgart, Arkansas. The Auburn stock came from Taiwan, and the Arkansas stock was imported from Malaysia (Courtenay et al. 1984). Grass carp have been recorded from 45 states; there are no reports of introductions in Alaska, Maine, Montana, Rhode Island, and Vermont ( <a href="http://nas.er.usgs.gov/fishes/accounts/cyprinid/ct_idell.html">http://nas.er.usgs.gov/fishes/accounts/cyprinid/ct_idell.html</a> ).”
<b>Date of Introduction:</b> 1963
<p><b>Life History:</b> “Grass carp spawned in the Ili River in 1972 and 1973 from mid May through late June, when water temperatures reached 18.7° and 23.5° respectively, with peak spawning noted when temperatures reached 19.5-19.9°. Spawning commenced after a rise in water level and considerable increase in turbidity (Nezdolii and Mitrofanov, 1975). In the Amur River, spawning takes place in the summer (June-July), with eggs drifting downstream at temperatures of 17-19°C, primarily near the surface, to the beginning of August (Krykhtin and Gorbach, 1981). Water level also appears to be important, with peak spawning associated with rises in water level, usually commencing only during rises above 20 cm to greater than 2 m and ceasing when the level begins to lower (Krykhtin and Gorbach, 1981).</p> <p>A 6 kg female from the Yangtse was reported to have more than 100,000 eggs (Chen and Lin, 1935), while others in the same drainage near Ichang had between 29,000 to 138,000 eggs (Nikol'skiy, 1956). Anishchenko (1939) noted 816,000 eggs in a 76cm 7.4 kg female. Chtang Yu-fan, et al. (1961) reported a 14.62 kg female bearing 960,000 eggs. Inaba et al. (1957) reported 485,000 eggs in a 88 cm, 7.135 kg female, and 800,000 eggs in a 81.5cm 12 kg fish, both from Japan. In India females between 2-6 kg were reported with fecundities of 82 eggs/g of body weight (Alikunhi, et al., 1963). In Malacca pond raised grass carp were found to bear between 2,000 and 37,000 eggs/kg of body weight (Hickling, 1967). In European latitudes fecundity ranged between an average 500,000-700,000 eggs in fish with an average weight of between 6-8 kg (Prikhod'ko and Nosal', 1963; Vinogradov, 1966; Aliyev, 1968; Vinogradov, et al., 1968; Vovk, 1968). In the Amur Basin found grass carp to bear between 237,00 to 1,687,000 eggs, with an average of 820,000 eggs in 7+ to 15+ year old fishes between 66-96 cm and 5.05-16.4 kg (Gorbach, 1972). Gorbach found fecundity is lowest in first time spawners and highest in large females that have spawned repeatedly.</p> <p>This species is known to hybridize with <i>Hypophthalmichthys molitrix</i> (Verigin, Makeyeva, and Shubnikova, 1975; Marian and Krasznai, 1978).</p> <p>Grass carp eggs may develop heterochronically, with an inverse relationship between development time of embryos in the egg capsule and time of hatching (Goryunova, 1971). Growth of juvenile carp in hatcheries was reported as inversely related to stocking density (Le Hoa, 1973). Condition factor for Amur River populations were reported as different between the sexes with males growing more quickly at small sizes and with females growing more quickly at large sizes (Gorbach, 1971).</p> <p>Electrophoretic analysis of muscle tissue has permitted differentiation of this species with the Silver Carp (<i>Hypophthalmichthys molitrix</i>) and the Bighead <i>Hypophthalmichthys nobilis</i>, as well as among geographic variants and hybrids between the species (Truvellet et al., 1973; Payusova and Tselikova, 1982) (<a href="http://www.gsmfc.org/nis/nis/Ctenopharyngodon_idella.html">http://www.gsmfc.org/nis/nis/Ctenopharyngodon_idella.html</a>).”</p>
<b>Growth/Size:</b> 125 cm ( <a href="http://nas.er.usgs.gov/fishes/accounts/cyprinid/ct_idell.html">http://nas.er.usgs.gov/fishes/accounts/cyprinid/ct_idell.html</a> ).
<b>Feeding Habits/Diet:</b> “Soft aquatic vegetation preferred by this herbivorous species in its natural and introduced habitat includes filiform, Ziz's pondweed, pondweed, hornwort, spiked milfoil, duckweed and water thyme. However, in their absence <i>C. idella</i> will consume corser macrophytic species including reeds, reed sweet-grass, reed-mace, sedges, bulrushes, and horsetail Verigin et al., 1963; Stroganov, 1963; Nikol'skiya and Verigin, 1966; Bobrova, 1968; Yaroshenko, et al., 1970; Gurova, 1972). In high numbers the grass carp has been reported to have significant impact on macrophytes and can remove, essentially all aquatic vegetation. All vegetation can be eliminated, even in large aquatic systems such as the 8,100 ha Lake Conroe in Texas (Klussmann, et al. 1988; Maceina, et al., 1992) ( <a href="http://www.gsmfc.org/nis/nis/Ctenopharyngodon_idella.html">http://www.gsmfc.org/nis/nis/Ctenopharyngodon_idella.html</a> ).”

**Habitat:** “The Grass Carp is a fish predominantly of great, warm rivers with gentle flow, sufficient depth and an abundance of blind river arms and quiet backwaters with rich plant growth.

Outside the spawning period, the Grass Carp keeps to backwaters and river arms, where it feeds on aquatic plants, benthos and insects flying near the surface. In winter the level of its activity drops and it withdraws to deeper places of the main river bed, where young and adult fish overwinter in separate shoals (<http://www.daiwasports.co.uk/woa/species/grasscarp.htm>).”

**Attitude (aggressive, etc.):** “Various authors (e.g., Shireman and Smith 1983; Chilton and Muoneke 1992; Bain 1993) have reviewed the literature on grass carp; most also discuss actual and potential impacts caused by the species' introduction. Shireman and Smith (1983) concluded that the effects of grass carp introduction on a water body are complex and apparently depend on the stocking rate, macrophyte abundance, and community structure of the ecosystem. They indicated that numerous contradictory results are reported in the literature concerning grass carp interaction with other species. Negative effects involving grass carp reported in the literature and summarized by these authors included interspecific competition for food with invertebrates (e.g., crayfish) and other fishes, significant changes in the composition of macrophyte, phytoplankton, and invertebrate communities, interference with the reproduction of other fishes, decreases in refugia for other fishes, and so on. In their overview, Chilton and Muoneke (1992) reported that grass carp seem to affect other animal species by modifying preferred habitat, an indirect effect. However, they also indicated that grass carp may directly influence other animals through either predation or competition when plant food is scarce. In his review, Bain (1993) stated that grass carp have significantly altered the food web and trophic structure of aquatic systems by inducing changes in plant, invertebrate, and fish communities. He indicated that effects are largely secondary consequences of decreases in the density and composition of aquatic plant communities. Organisms requiring limnetic habitats and food webs based on phytoplankton tend to benefit from the presence of grass carp. On the other hand, Bain reported that declines have occurred in the diversity and density of organisms that require structured littoral habitats and food chains based on plant detritus, macrophytes, and attached algae. Removal of vegetation can have negative effects on native fish, such as elimination of food sources, shelter, and spawning substrates (Taylor et al. 1984). Hubert (1994) cited a study that found vegetation removal by grass carp lead to better growth of rainbow trout due to increases in phytoplankton and zooplankton production, but it also lead to higher predation on rainbow trout by cormorants *Phalacrocorax auritus* due to lack of cover, and changes in diet, densities, and growth of native fishes. Although grass carp are often used to control selected aquatic weeds, these fish sometimes feed on preferred rather than on target plant species (Taylor et al. 1984). Increases in phytoplankton populations is a secondary effect of grass carp presence. A single grass carp can digest only about half of the approximately 45 kg of plant material that it consumes each day. The remaining material is expelled into the water, enriching it and promoting algal blooms (Rose 1972). These blooms can reduce water clarity and decrease oxygen levels (Bain 1993). In addition to the above, grass carp may carry several parasites and diseases known to be transmissible or potentially transmissible to native fishes. For instance, it is believed that grass carp imported from China were the source of introduction of the Asian tapeworm *Bothriocephalus opsarichthydis* (Hoffman and Schubert 1984; Ganzhorn et al. 1992). As such, the species may have been responsible indirectly for the infection of the endangered woundfin *Plagopterus argentissimus* (by way of the red shiner *Cyprinella lutrensis*) (Moyle 1993) ([http://nas.er.usgs.gov/fishes/accounts/cyprinid/ct\\_idell.html](http://nas.er.usgs.gov/fishes/accounts/cyprinid/ct_idell.html)).”

**Physical Description:** “Distinguishing characteristics were given in Berg (1949), Shireman and Smith (1983), and Page and Burr (1991). Keys that include this species and photographs or illustrations were provided in most of the more recently published state and regional fish books (e.g., Robison and Buchanan 1988; Etnier and Starnes 1993; Jenkins and Burkhead 1994; Pflieger 1997) ([http://nas.er.usgs.gov/fishes/accounts/cyprinid/ct\\_idell.html](http://nas.er.usgs.gov/fishes/accounts/cyprinid/ct_idell.html)).”

**Management Recommendations / Control Strategies:** include references for existing site-specific strategies

“Because concern of unwanted introductions and undesirable impacts on natural vegetation, all 50 states have some restrictions on their use in weed control. Initial efforts to prevent unwanted introductions included creation of all female populations through gynogenesis (Stanley, 1976), through hormonal implants followed by mating sex-reversed males to normal females (Boney et al, 1984), or through gonadectomy. However, such monosexual populations remain fertile and chance introduction or production of males may lead to reproduction (Chourrout and Quillet, 1982). Gonadectomy are not effective in stemming reproduction because the gonads are capable of rapid regeneration (Clippinger and Osborne, 1984; Underwood et al., 1986).

Discovery that F1 hybrids of intergeneric crosses between female *C. idella* and male *Hypophthalmichthys nobilis* were 100% triploid, led to the use of triploids in commercial weed control (Malone, 1984). However, subsequent commercial efforts to duplicate this finding produced only 67% triploidy (Allen and Wattendorf, 1987). Later, Cassani and Caton (1985) discovered that cold shocks could produce 50-100% triploidy with egg survival of less than 20%. Extending these findings, Cassani and Caton (1986) utilizing hydrostatic pressure treatments at 7000 to 8000 psi produced nearly 100% triploidy with 30% mortality. Bonar et al. (1984) noted that diploids could be differentiated from triploids on the basis of meristics and morphometrics, but only through use of multivariate methods. Consequently, enforcement of stocking regulations may be difficult without determination of ploidy through microscopic examination or the use of a Coulter Counter. The latter is a device that takes advantage of differential resistance of particles, in this case erythrocytes, of different size in passing through an orifice between two electrodes. Because triploids have larger erythrocytes and nuclei than diploids, it is possible to separate the two with nearly 100% accuracy (Beck and Biggers, 1983; Benfey et al, 1984; Johnson et al., 1984; Wattendorf, 1986). Triploid grass carp produce only rudimentary gonads (Doroshov, 1986). Allen et al. (1986)

and Allen and Wattendorf (1987) noted that while it is possible for triploid carp to produce offspring through mating with diploid adults, the vast majority are sterile, probably because the sperm are aneuploid. Consequently, although reproductive they are functionally sterile, with only 0.00000012 of the gametes fertile ([http://www.gsmfc.org/nis/nis/Ctenopharyngodon\\_idella.html](http://www.gsmfc.org/nis/nis/Ctenopharyngodon_idella.html)).”

References (includes journals, agency/university reports, and internet links):

1. [http://nas.er.usgs.gov/fishes/accounts/cyprinid/ct\\_idell.html](http://nas.er.usgs.gov/fishes/accounts/cyprinid/ct_idell.html). USGS Nonindigenous Aquatic Species Accounts.
2. [http://www.gsmfc.org/nis/nis/Ctenopharyngodon\\_idella.html](http://www.gsmfc.org/nis/nis/Ctenopharyngodon_idella.html). Gulf of Mexico Program Species Summary.
3. <http://www.daiwasports.co.uk/woa/species/grasscarp.htm>. Web of Angling Species Descriptions.
4. Shireman, J. V., and C. R. Smith. 1983. Synopsis of biological data on the grass carp *Ctenopharyngodon idella* (Cuvier and Valenciennes, 1844). FAO Fisheries Synopsis No. 135. Food and Agriculture Organization of the United Nations (FAO), Rome, Italy. 86 pp.
5. Courtenay, W. R., Jr., D. A. Hensley, J. N. Taylor, and J. A. McCann. 1984. Distribution of exotic fishes in the continental United States. Pages 41-77 in W. R. Courtenay, Jr., and J. R. Stauffer, Jr., editors. Distribution, biology and management of exotic fishes. Johns Hopkins University Press, Baltimore, MD.
6. Nezdolii, V.K., V.P. Mitrofanov. 1975. Natural reproduction of the grass carp, *Ctenopharyngodon idella*, in the Ili River. Journal of Ichthyology 15:927-933.
7. Krykhtin, M. L. and E. I. Gorbach. 1981. Reproductive ecology of the white amur *Ctenopharyngodon idella* (Val.) and of the silver carp *Hypophthalmichthys molitrix* (Val.) in the Amur Basin. Journal of Ichthyology 21(2):109-123.
8. Nikol'skiy, 1956. Fish of the Amur basin. Moscow, Acad. Sci. USSR Press.
9. Chen, C.S., and S.V. Lin. 1935. The fish fry industry of China. Bull Chekiang Province Fisheries Experiment Station. Tanghai, 1(4).
10. Anishchenko, 1939. On the acclimation of Amur fish in the European areas of the USSR. Rybn. Khoz. No. 5.
11. Chtang Yu-fan, Cheng Chieh, Wang Chiang-Chi, and Liu Tsao-fai. 1961. Rybnoye khozyaystvo vnutrennikh vod Kitaya (The fish industry of Chinese inland waters). Peking.
12. Inaba, D., M. Nomura, and M. Nakamura. 1957. Preliminary report on the spawning of grass carp and silver carp in the Tone River, Japan and the development of their eggs. J. Tokyo Univ. Fish., 43(1).
13. Alikunhi, K.H., K.K. Sukumaran, and S. Parameswaran. 1963. Induced spawning of the Chinese grass carp (*Ctenopharyngodon idellus*), and the silver carp (*Hypophthalmichthys molitrix*) in ponds at Cullack, India. Indo-Pacific. Fish Council. Proc. Sec., 2, Bangkok.
14. Hickling, C. F. 1967. On the biology of herbivorous fish, the white amur, or grass carp *ctenopharyngodon idella* Val. Proc. Roy. Soc. Edinb. 70B Pt. 1(4): 62-81.

Additional references are listed in the bibliography.

#### Available Mapping Information:

1. USGS Nonindigenous Aquatic Species Accounts. [http://nas.er.usgs.gov/fishes/accounts/cyprinid/ct\\_idell.html](http://nas.er.usgs.gov/fishes/accounts/cyprinid/ct_idell.html)
2. Gulf of Mexico Program Species Summary. [http://www.gsmfc.org/nis/nis/Ctenopharyngodon\\_idella.html](http://www.gsmfc.org/nis/nis/Ctenopharyngodon_idella.html) and [http://www.gsmfc.org/nis/nis/nrange/Ctenopharyngodon\\_idella\\_non-native\\_range.html](http://www.gsmfc.org/nis/nis/nrange/Ctenopharyngodon_idella_non-native_range.html)